significant number of unlicensed devices meeting only interim sharing criteria could negatively impact the efficiency and utility of devices complying with later-developed, more robust sharing rules. On balance, as discussed below, WINForum believes that the best practical and policy solution would be to permit limited early deployment in certain bands with a date-certain changeover mandate and to expedite the development of industry consensus sharing rules.

WINForum believes there are some benefits to early deployment. First and foremost, interim use of the NII/SUPERNet band will allow some early adopters to benefit from the use of advanced telecommunications systems. In addition, early deployment will allow manufacturers to obtain valuable real world experience with products, testing systems and refining functionalities desired by consumers. Finally, early deployment will provide software developers needed testbeds to create the interfaces and supporting applications to allow transparent use of NII/SUPERNet devices over the longer term.

While early deployment should be permitted, interim devices should be constrained to limit precluding the use of more efficient sharing rules. WINForum therefore suggests that any interim deployment of new systems should be restricted to a subset of the NII/SUPERNet band. Specifically, WINForum suggests allowing use of no more than 50 MHz in the 5.8 GHz ISM band where NII/SUPERNet devices will have to contend with other spectrum users in any event. This environment will offer the benefits of early deployment, since a few channels should provide sufficient interim capacity, without creating an embedded base of devices that could interfere with later-deployed products. Interim devices should also be

deployed with a fixed, deadline for compliance with a later-adopted spectrum sharing rules, which WINForum suggests as June 30, 1998.

WINForum also believes that the use of a "listen-before-talk" requirement, standing alone, may not be appropriate for interim devices. The listen-before-talk protocol proposed in the *Notice* was developed for a far different environment at 2 GHz and may not be appropriate in a band where the trade-offs and spectrum considerations that apply to unlicensed PCS frequencies are not present. Thus, while the listen-before-talk procotol is appropriate at 2 GHz frequencies, and while the ultimate rules for 5 GHz NII/SUPERNet devices may employ some form of listen-before-talk as part of a larger interference prevention scheme, an interim listen-before-talk scheme on its own may preclude the use of other, more effective interference protection measures. Instead, WINForum recommends adopting interim rules that permit deployment of *any* devices in the interim band within the 5.8 GHz band that meet a power spectral density limit of 9 dBW/MHz EIRP and out-of-band emissions limits for the band.[43]

To limit the preclusive effect of interim devices, WINForum believes that a robust, technically sound, and industry consensus sharing rules can be developed over a short period. WINForum, as previously noted, has taken up the challenge of drafting a set of proposed sharing rules and has invited participation by any entities interested in manufacturing products for the band. WINForum's new subcommittee will hold its initial meeting in the Denver, Colorado area on July 30, 1996, and WINForum hopes to have an initial proposal drafted by

---

[43]This is based on the maximum allowed EIRP (6 dBW) currently allowed under Section 15.247 for unlicensed spread spectrum systems operating in the 5.725-5.850 GHz band, and the minimum bandwidth (500 kHz) for a direct sequence system. Note that this limit may change as proposed in ET Docket 96-8.

the end of the year. WINForum will keep the Commission apprised of its progress in this regard.

V. TECHNICAL STANDARDS FOR NII/SUPERNET DEVICES SHOULD MAXIMIZE EFFICIENCY AND UTILITY FOR ALL USERS

A. The Proposed Power Limits Should Be Revised To Permit Deployment of Directional Transmit Antennas and the Power Limit for the ISM Band Should Be Conformed to the Spread Spectrum Device Limits

The *Notice* proposes to adopt a uniform power limit for all NII/SUPERNet devices of -10 dBW, or 100 mW, effective isotropic radiated power. While WINForum believes that a *actual radiated power* limit of approximately 100 mW may be appropriate for the lower (5.15-5.35 GHz) part of the band, the rules should also permit the use of transmit antennas with up to 6 dB of gain. Moreover, in the upper (5.725-5.875 GHz) band, devices should be permitted to operate with a power spectral density on par with other spread spectrum Part 15 operations in the band.[44]

Proposed 100 mW EIRP power limit. WINForum's original petition was premised upon achieving reliable on-premises communications at distances of up to 40 meters. While WINForum's preliminary studies indicate that such a range can be achieved with an actual

---

[44]As a clarification, WINForum notes that its original petition contemplated a power limit of one Watt for the 5.15-5.35 GHz band. The reference in Exhibit B to the SUPERNet Petition was an estimate of the average power emitted by SUPERNet devices, taking into account averaging over a large number of units with automatic power control and taking into account the loss of gain in the vertical plane for calculations involving "look" angles to satellites. In fact, HIPERLAN devices in Europe are contemplated to operate at a power limit of one Watt in the 5.15-5.25 GHz band and the previous technical material submitted by WINForum assumed a limit of one Watt.

radiated power level of approximately 100 mW (with the power definition proposed herein), WINForum is studying this matter further and taking into consideration the effects of various in-building propagation problems. Moreover, the sharing rules drafting subcommittee of WINForum intends to examine a range of interference reduction measures that may including compensating for directional antenna use. This, in turn, may lead to sharing rules that are adaptable for systems with power limits slightly above 100 mW. WINForum accordingly urges the Commission to remain flexible in potentially considering a minor adjustment of the power limit, *e.g.*, possibly up to 250 mW.

Use of directional antennas. As discussed previously, directional antenna use is not always a significant factor in assessing interference potential. The interference calculations relevant to the 5.15-5.35 GHz band, for example, postulated large numbers of devices with random orientations, which means that the increased power directed towards any receiver will be offset by the decreased power level of nearby units not oriented toward the receiver. In these cases, the more important factor for overall interference continues to be the actual radiated power, which is proposed to be approximately 100 mW. At the same time, given the propagation factors at 5 GHz, directional transmit antenna use may facilitate communications between NII/SUPERNet devices and limit interference between such devices.

Under the circumstances, WINForum supports allowing the use of NII/SUPERNet device antennas with up to 6 dB of gain. Furthermore, WINForum believes that the rules for NII/SUPERNet devices should permit a "dB for dB" adjustment of actual radiated power and antenna gain, allowing antenna gains higher than 6 dB with lower radiated transmit power. This would provide manufacturers with the flexibility to use higher gain antennas with lower

transmit powers to achieve longer battery life while maintaining the reliability of transmissions. WINForum tentatively estimates that these limits provide a good balance between spectrum use efficiency and interference potential. However, WINForum will instruct the sharing rules drafting subcommittee to study this further and may modify the proposal.

Technology-neutral power limits for NII/SUPERNet devices in the 5.8 GHz band. WINForum also believes that the power limits for NII/SUPERNet devices operating in the ISM band should be altered to place NII/SUPERNet devices on a more equal footing with respect to Part 15 spread spectrum devices in the band. As WINForum has previously noted, the Commission's ET Docket No. 96-8 has proposed to extend the EIRP limits for unlicensed Part 15 spread spectrum systems at 5.8 GHz. Because NII/SUPERNet devices must operate in this environment, WINForum suggests altering the NII/SUPERNet rules for the 5.8 GHz band to allow such users power spectral densities (*i.e.*, EIRP per MHz) on par with the rules adopted in ET Docket No. 96-8.

Power measurement criteria. As a final matter, WINForum also proposes definitions to clarify the measurement of transmit power for NII/SUPERNet devices. Specifically, WINForum suggests adopting the following definition:

> *Transmit Power.* The total energy transmitted over a time interval of at most 30/B (where B is the emission bandwidth of the signal), divided by the interval duration.

WINForum notes that this proposed definition is consistent with the definition adopted by ANSI C63 SC7 in the draft standard for verifying compliance of Unlicensed PCS devices with FCC Part 15, Subpart D, and SC7 has developed methods for measuring peak power in

accordance with this definition.[45] Use of the proposed definition will control the interference potential of compliant devices without compromising the value of advanced digital modulation techniques that may be used to optimize spectrum utilization. In effect, the choice of measurement interval balances the power penalty for variable envelope signals on the one hand and limitations on the interference on the other. The 30/B interval proposed by WINForum is approximately the time needed to send 20 digital symbols (*e.g.*, 40 bits with 4 level signaling), yet is too short for a transmitter to gain a power level advantage by, for example, sending short bursts of high power.

B. A Channelization Plan Should Be Adopted That Ensures High Throughput and Efficiency

One of the primary benefits of allocating new spectrum at 5 GHz for unlicensed devices is allowing the operation of systems using a broader bandwidth with greater carrying capacity than existing narrowband systems. Accordingly, WINForum opposes the *Notice* proposal not to adopt a channelization plan for the 5 GHz band. Moreover, as discussed below, efficiency concerns dictate adopting minimum -- not maximum -- channel bandwidths to ensure the best use of spectrum allocated for NII/SUPERNet devices. Because there is some spectrum already available for narrower bandwidth applications, spectrum in the 5 GHz band should be reserved for systems that require greater capacity throughput.

---

[45]In a separate filing, WINForum has also requested adoption of this clarification with respect to Section 15.300.

Broadband networking is clearly the trend. For bandwidth intensive applications, such as multimedia use, broadband channels must be viewed as an imperative. Moreover, spectrum does exist in other bands for narrower bandwidth systems. What is lacking is sufficient frequency space to create a core of broadband channels -- what WINForum has been calling the "unique opportunity" at 5 GHz. WINForum believes that it in order to realize the benefits of advanced wireless communications promised by NII/SUPERNet devices, it is thus *absolutely critical* to mandate a *minimum*, not a *maximum*, channel bandwidth. If both types of narrow and broadband channels are mixed, the efficiency of the system plunges because a single narrowband user can preclude a broadband user from gaining access to the spectrum. In effect, a user seeking a 20 MHz channel would have to ensure that no other transmitters were operating on any of the 20 discrete one MHz channels within the broadband channel before using it, even if 19 out of the 20 channels were unoccupied.

In this regard, WINForum supports a minimum channel spacing on the order of 20 MHz, with appropriate requirements to evenly distribute the power between channel spacings in order to preserve spectrum use efficiency. WINForum also believes that NII/SUPERNet users should be permitted to combine channels for maximal efficiency. And, to the extent narrower channel spacings are permitted, they should be permitted only in the 5.8 GHz ISM band.

As a final matter, the *Notice* also requests comment on adopting "a minimum modulation efficiency requirement," such as "1 bps/Hz or higher."[46] While WINForum

---

[46]*Notice* at ¶53.

supports efficient use of the spectrum, modulation efficiency does not accurately measure efficient use because it lacks any reference to geographic co-existence potential. For example, one class of modulation techniques (e.g., 64-QAM), may have a very high bps/Hz "rating," but may require greater separation between co-channel systems. Conversely, with spread spectrum systems, large numbers of "low efficiency" systems (as measured in bps/Hz) can simultaneously co-exist in the same area at the same time. Thus, a straight bps/Hz efficiency metric is not adequate. Under the circumstances, WINForum believes any efficiency rating must take into account the ability of the modulation technique to co-exist with other devices of different classes in the same geographic area -- a bps/Hz/cell requirement. Unfortunately, there is no simple means for measuring "bps/Hz/cell" without a large number of speculative assumptions, and therefore it would be difficult to assess compliance of NII/SUPERNet devices. WINForum has nonetheless asked its 5 GHz Sharing Rules Drafting subcommittee to take up this issue in its deliberations to determine if some efficiency metric is at once accurate and measurable.

C. Channel Sharing Rules Should Be Adopted Through Industry Consensus Procedures That Accommodate All Potential Uses and Promote Fair and Equal Access to Spectrum Resources

The *Notice* observes that "some basic sharing protocol is necessary to ensure that [NII/SUPERNet] spectrum is used by unlicensed devices in a manner that permits these

devices to share with one another."[47] The *Notice* then "encourage[s] industry to develop appropriate etiquette protocols through a cooperative consensus process."[48]

WINForum believes that all parties have recognized that in order to promote spectrum efficiency and to ensure fair and equitable access to this band by devices of all classes, sharing rules will be necessary governing the operation of NII/SUPERNet devices. In WINForum's petition, and in a subsequent letter filed jointly by Apple Computer, Inc. and WINForum, the need to develop these rules with input from other interested manufacturers and developers was similarly noted. In order to focus this effort in a timely manner and to take up the challenge made by the Commission, WINForum has constituted a new subcommittee charged with drafting proposed technical sharing rules for the 5 GHz band.

WINForum's 5 GHz Sharing Rules Drafting Subcommittee will hold its organizational meeting on July 30th of this year. In order to facilitate access by companies and entities from across the country, the meeting will be held in the Denver, Colorado area with a specific site location to be announced after initial attendance confirmations are received. WINForum is inviting any and all interested entities to participate in the organizational meeting, and has distributed an invitation to a wide variety of organizations representing all aspects of the computer and communications industries. In order to assure the broadest attendance at the initial meeting, the normal ongoing WINForum membership requirement will be waived.

---

[47] *Id.* at ¶52.

[48] *Id.*

WINForum will keep the Commission apprised of its progress in this regard, but hopes to have initial draft sharing rules by the end of the year.

D. The Emissions Radiated Outside the Frequency Band of Operation Should Be Stated in Terms of Average Burst Power and Should Be Independent of the Fundamental Emission Level

The *Notice* proposes to require that the emissions radiated outside the frequency band of operation "be attenuated by at least 50 dB or to the radiated emission limits set forth in Section 15.209, whichever is the lesser attenuation."[49] However, WINForum believes instead that the emissions radiated outside of the NII/SUPERNet band of operation should be stated in terms of average burst power and should be independent of the fundamental emission level. Specifically, WINForum recommends that the rules: (1) specify the limit in terms of an absolute value independent of the power of the fundamental emission; (2) specify the power as the burst average power with a 100 kHz measurement bandwidth; and (3) set a power limit of -33 dBm/100 kHz.

Because the bandwidth and definition of the emission power are not defined in the *Notice*, WINForum has assumed that the Commission intended to use the same criteria specified in Section 15.209. Section 15.209, referencing Section 15.35, defines the power as the average over a 100 millisecond interval or 20 dB below the peak envelope power, whichever is less. Instead, however, WINForum suggests specifying the limit as an absolute value independent of the fundamental power. This would permit the limit to be met by

---

[49] *Id.* at ¶49.

reducing the in-band power while enforcing the same interference criteria. This is desirable because it would sometimes be an inducement to reduce the overall co-channel power while at the same time giving more freedom to produce low cost systems.

WINForum also suggests specifying the power as the burst average power with a 100 kHz measurement bandwidth. The peak envelope power of Section 15.35 will be the limiting quantity for virtually all NII/SUPERNet devices because of the very low on-time duty cycle. However, the burst average power is more precisely related to the interference effect than is the peak envelope power and the burst average power is now as easily measured. For example, the 100 kHz measurement bandwidth is the bandwidth used to measure European HIPERLAN out-of-band emissions and is near the 150 kHz bandwidth used by MLS receivers. Thus, specifying power as the burst average power with a 100 kHz measurement bandwidth is better correlated to controlling the actual interfering effect on the major adjacent band equipment.

WINForum believes that specifying a power limit of -33 dBm/100 kHz is approximately the same as the proposed limit under most circumstances. WINForum interprets the 50 dB rejection requirement of the *Notice* to apply to the power level defined in Section 15.35. Further, WINForum assumes that the measurement bandwidth for Section 15.35 is 1 MHz. Section 15.35 sets the peak envelope power limit 20 dB higher than the average power limit, thus the required attenuation of the peak envelope power is currently 30 dB. This requires the peak envelope power per one MHz to be -10 dBm with a 100 mw fundamental power level. The corresponding 100 kHz value should be - 20 dBm using the usual bandwidth correction factor.

The burst average power created by modulation products will be less than the peak envelope power. The difference depends on the modulation used and other factors, but can be expected to range between 10 and 16 dB. Thus, the current limit translates to a burst average power in the range -30 dBm to - 36 dBm per 100 kHz for most equipment. The WINForum proposed limit falls in the middle of this range and is also the same as the European HIPERLAN limit which is -33 dBm/100 kHz within 150 MHz of the HIPERLAN band. CEPT has established that this limit is consistent with adjacent channel operation of MLS equipment.[50]

A definition of "average burst power" is needed. WINForum suggests that the following definitions should be added to Section 15.401:

- *Burst Power (per bandwidth B):* The burst power per bandwidth B for a modulated RF burst is the energy out of a dissipationless bandpass filter of bandwidth B resulting from application of the burst divided by the duration of the input burst

- *Average Burst Power (per bandwidth B):* The average burst power per bandwidth B for a sequence of RF bursts is the average of the burst power per bandwidth B of the individual bursts.

With these changes, WINForum believes that NII/SUPERNet devices will protect out-of-band users, such as MLS, without unduly constraining design flexibility.[51]

---

[50]Conference of Postal and Telecommunications Administrations (CEPT), ERC Report 14 (Madrid October 1992).

[51]In this regard, WINForum also suggests removing the 5.35 - 5.46 GHz range from the restricted list. WINForum estimates that the restricted band limit translates to about 10 MHz spectrum loss at the upper end of the band if the restricted band limit must be met. The only application here that is not in the surrounding bands is FCC Part 87, Aviation Services.

E. WINForum Agrees That a "Safe Harbor" Should Be Adopted To Provide Assurances for NII/SUPERNet Device Users

In the *Notice*, the Commission also suggests adopting a "safe harbor" whereby "users of NII/SUPERNet devices may operate without risk of being considered sources of harmful interference."[52] WINForum concurs with this approach, which is consistent with the direction taken by the Commission in the Location Monitoring Service proceeding. By creating a safe harbor defined by "clear technical parameters,"[53] users will be afforded a degree of certainty that is highly desirable. Indeed, creating such a safe harbor, in large part, satisfies the policies underlying proposals for a "Part 16" status by offering NII/SUPERNet users reassurances that their operations are consistent with the rules, even if not strictly protected from interference.

VI. WINFORUM SUPPORTS DEVELOPMENT OF COMMUNITY NETWORK SYSTEMS IN THE 5.8 GHz BAND

The *Notice* also requests comment on deployment of longer range "community network" systems in the 5.8 GHz band. As noted in the letter jointly filed by Apple Computer, Inc. and WINForum, both parties believe that community networks are a necessary and desirable component of next generation networks. Furthermore, as previously noted, allowing operation on a technology-neutral basis compared to spread spectrum systems in the

---

The 5.35-5.46 band is allocated to airborne radars and beacons in Part 87.

[52] *Notice* at ¶54.

[53] *Id.*

band would not appear to cause interference to existing users. Since many aspects of community networks could be deployed through such measures, WINForum supports technical changes to allow such operation.

VII. WINFORUM OPPOSES THE USE OF COMPETITIVE BIDDING MECHANISMS FOR ANY UNLICENSED ALLOCATIONS

While WINForum generally agrees with the prevailing sentiment that the public should be compensated for the value of the use of radio spectrum, the *public* is, in fact, the direct beneficiary of unlicensed radio allocations. Unlicensed allocations play an important role in the U.S. telecommunications infrastructure and arguably are close to the ideal of allocating spectrum purely for the public good. Under the circumstances, WINForum strongly opposes the use of auction based mechanisms for any unlicensed spectrum, including for "community network" spectrum. Unlicensed allocations provide no right to exclusive use by any entity (or to the profit, if any, from such use). There is also no practical way to evaluate comparative value for entities sharing the use of such frequencies because metering airtime usage in an ad hoc network environment does not appear to be technically feasible. There is no equitable means to assess interested parties for contributions in advance of allocating such spectrum and, by definition, no further licenses (that could be auctioned) are needed.

Beyond the obvious practical difficulties of developing a compensatory auction scheme that allows participation by the unlicensed community, auction-based surrogate payment systems may exclude from these allocations precisely the types of companies that the FCC should be attempting to attract. The Omnibus Budget Reconciliation Act, for example,

expressly directs the Commission to increase entry opportunities for small businesses.[54] Regardless of whether bidding credits or other incentives are employed, many of these small companies do not have the resources to pursue licenses at auction, or even to deploy the infrastructure necessary to implement a system that accommodates public users with airtime charges to create return on investment. Many of these same companies, however, do have innovative ideas that can be brought to fruition through unlicensed allocations.

VIII. CONCLUSION

WINForum strongly supports the Commission's proposal to allocate spectrum in the 5 GHz band for new NII/SUPERNet devices. These unlicensed products promise substantial benefits by allowing students, doctors, library users, businessmen, and everyday consumers to harness the power of the National Information Infrastructure in simple, low-cost, easy to use

---

[54]*See, e.g.*, 47 U.S.C. §309(j)(3)(B).

packages. With the minor modifications suggested herein, WINForum urges the Commission to adopt its proposal rapidly and expedite the availability of next-generation unlicensed products for all Americans.

Respectfully submitted,

WIRELESS INFORMATION
NETWORKS FORUM

By: J. Ron Cross

J. Ron Cross, Chairman
Wireless Information Networks Forum
1200 19th Street, N.W., Suite 300
Washington, D.C. 20036-2401
(202) 429-5138

Dated: July 15, 1996